

Evaluating the Health of Maine's Streams and Rivers

Tom Danielson
Maine DEP

Little Black River, Allagash

Overview

- Introduce the Biological Monitoring Program
 - How we evaluate the health of streams and rivers with aquatic life.
 - Introduce our efforts to develop new tools to better inform management decisions.

Classes and Criteria

Numeric Criteria

Dissolved Oxygen

Bacteria (*E. coli*)

Habitat

Aquatic Life (Biological)

Narrative Criteria

Aquatic Life (Biological)

Class AA

as naturally occurs

as naturally occurs

free flowing and natural

as naturally occurs

Class B

7 ppm; or
75% sat.

as naturally occurs

natural

as naturally occurs

Class C

7 ppm; or
75% sat.

as naturally occurs

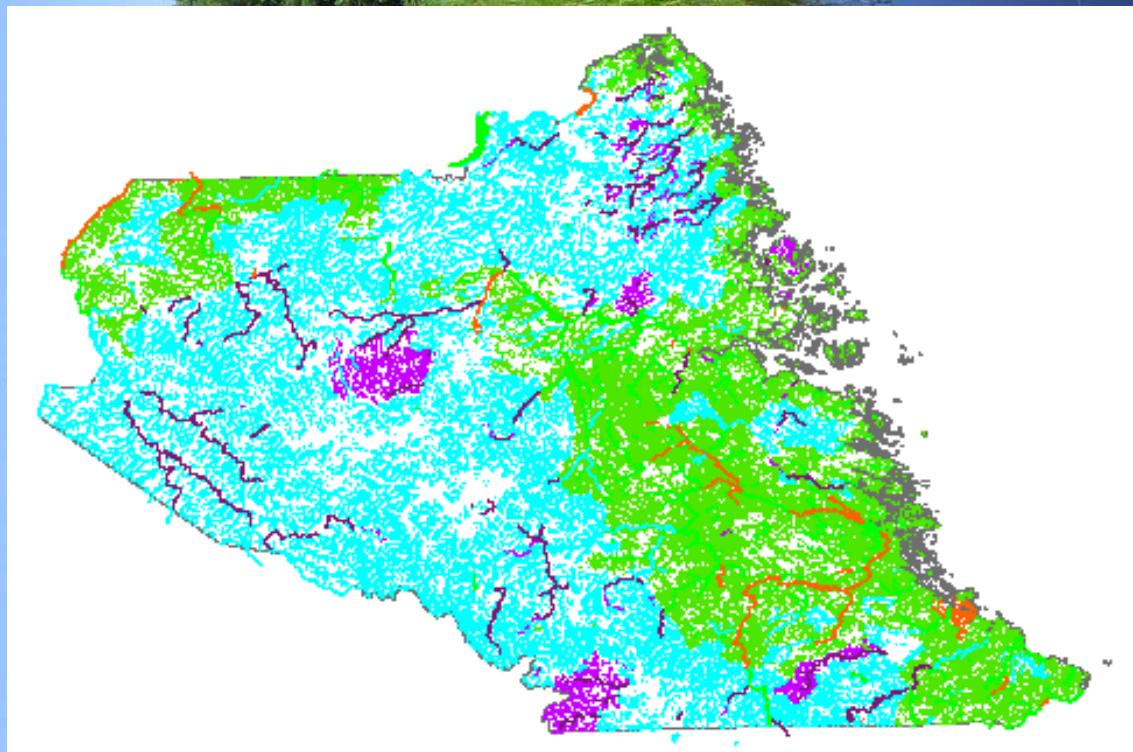
unimpaired

support all aquatic species indigenous to the receiving water; no detrimental changes to the resident biological community

Non-attainment (NA)

stream does not meet minimum criteria

Stream Classes



AA

A

B

C

Maine DEP's Biological Monitoring Unit

- Determine if streams, rivers, and wetlands are attaining aquatic life criteria
- Provide water quality data for many other programs
- 24 years with stream macroinvertebrates.
- 8 years with stream and wetland algae and wetland macroinvertebrates.



Leon Tsomides

Beth Connors

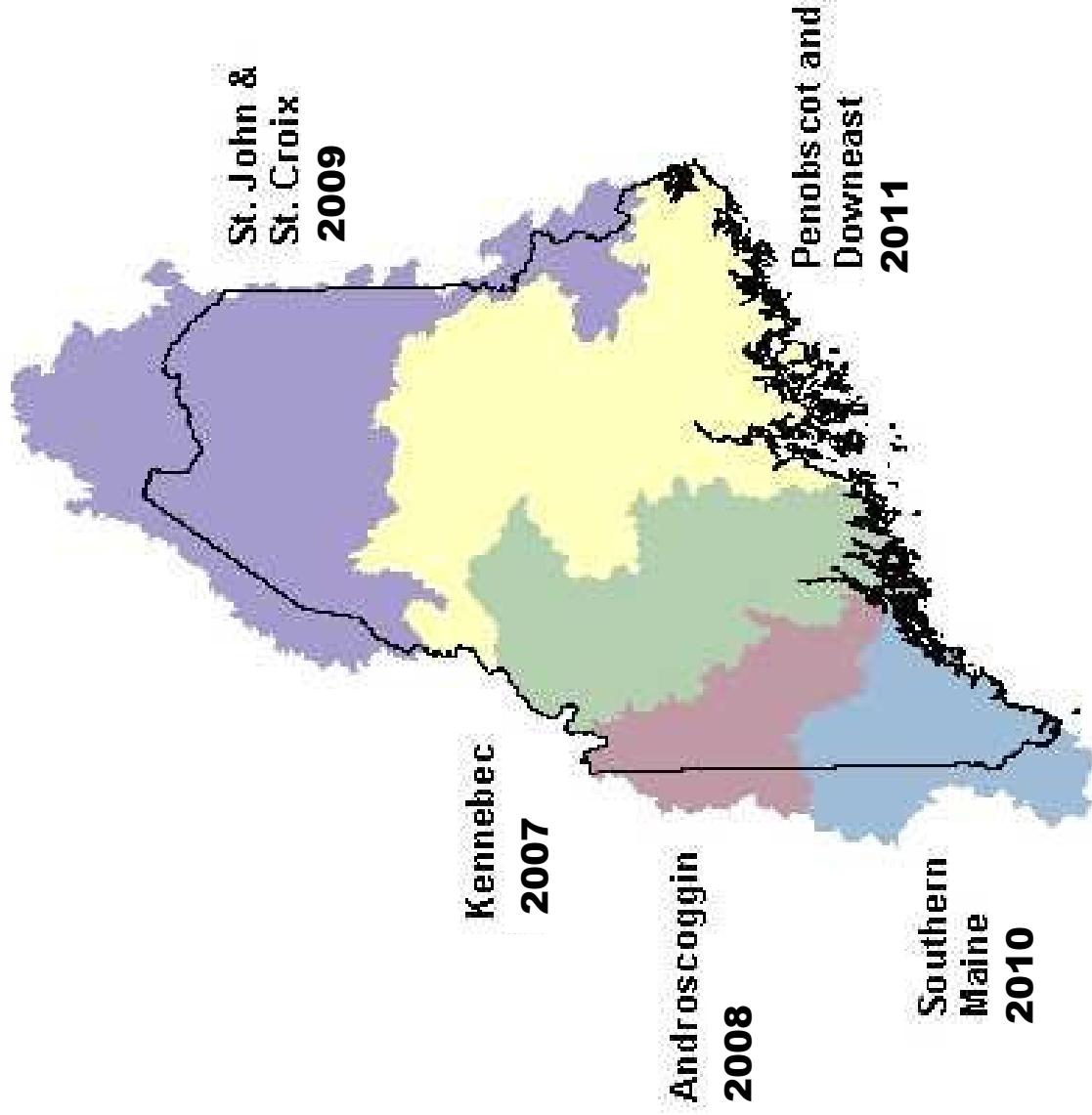
Jeanne DiFranco

Tom Danielson

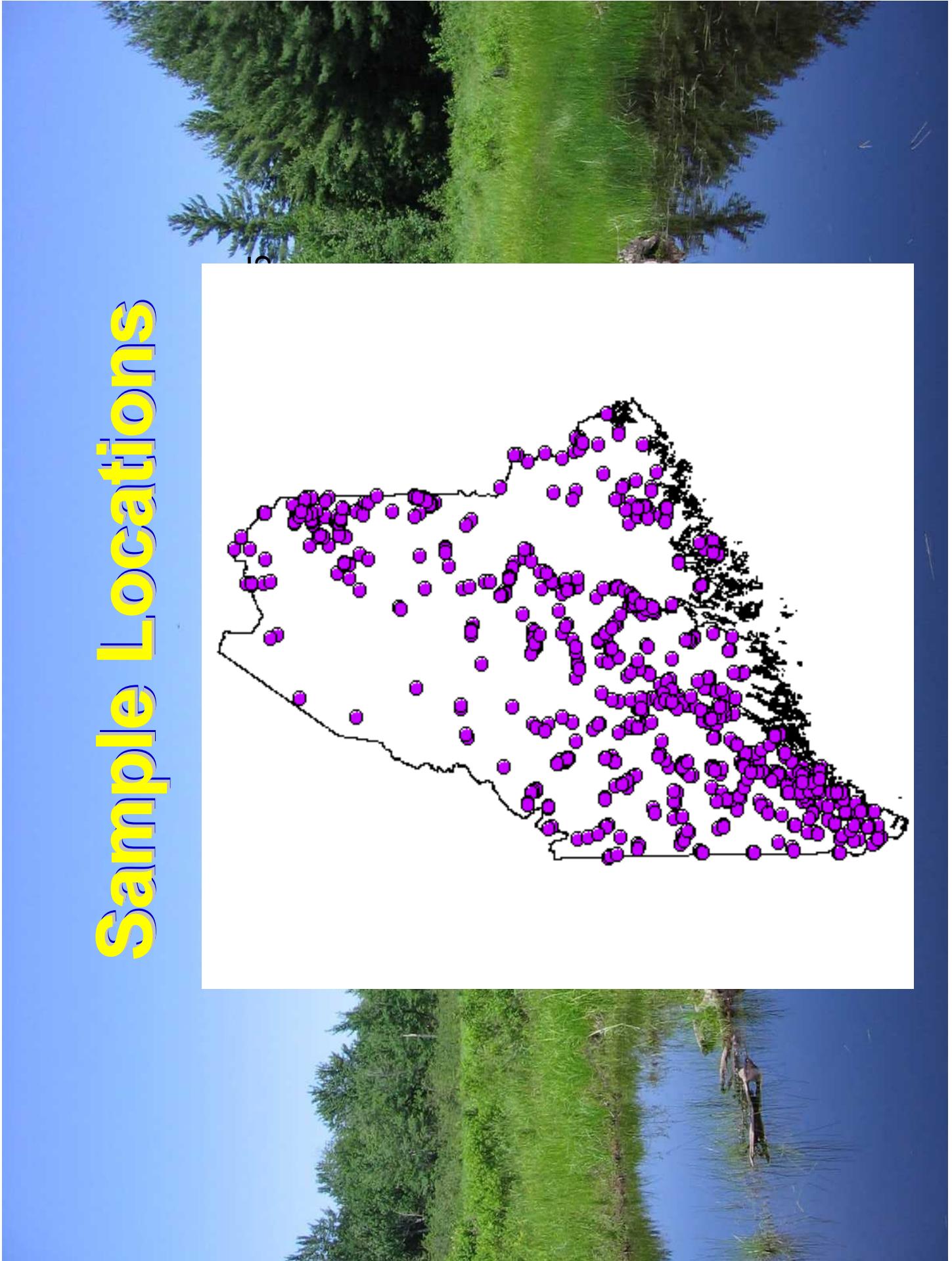
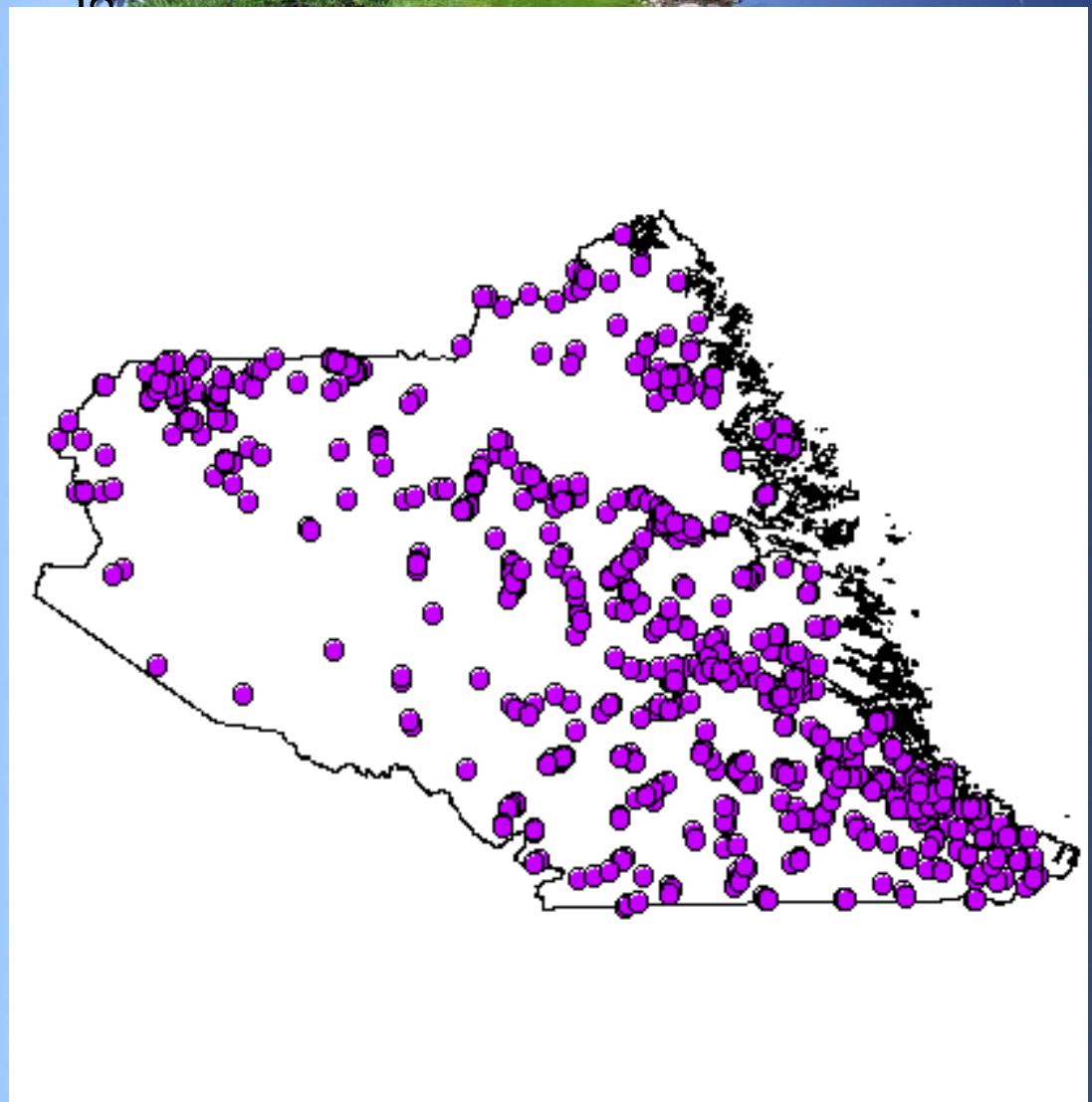
Why Monitor Aquatic Life?

- Much better indicator of stream health than sampling chemicals.
 - There are too many chemicals to monitor.
 - We may not measure the “right” chemical.
 - We may not measure at the “right time”.
- Many stressors can damage streams:
 - Pollution, changes in hydrology, habitat degradation, invasive species, increased temperature, etc.
- Aquatic life reflect a time-integrated, holistic measure of stream health.

Maine DEP Biomonitoring Program Rotating Basin Approach



Sample Locations



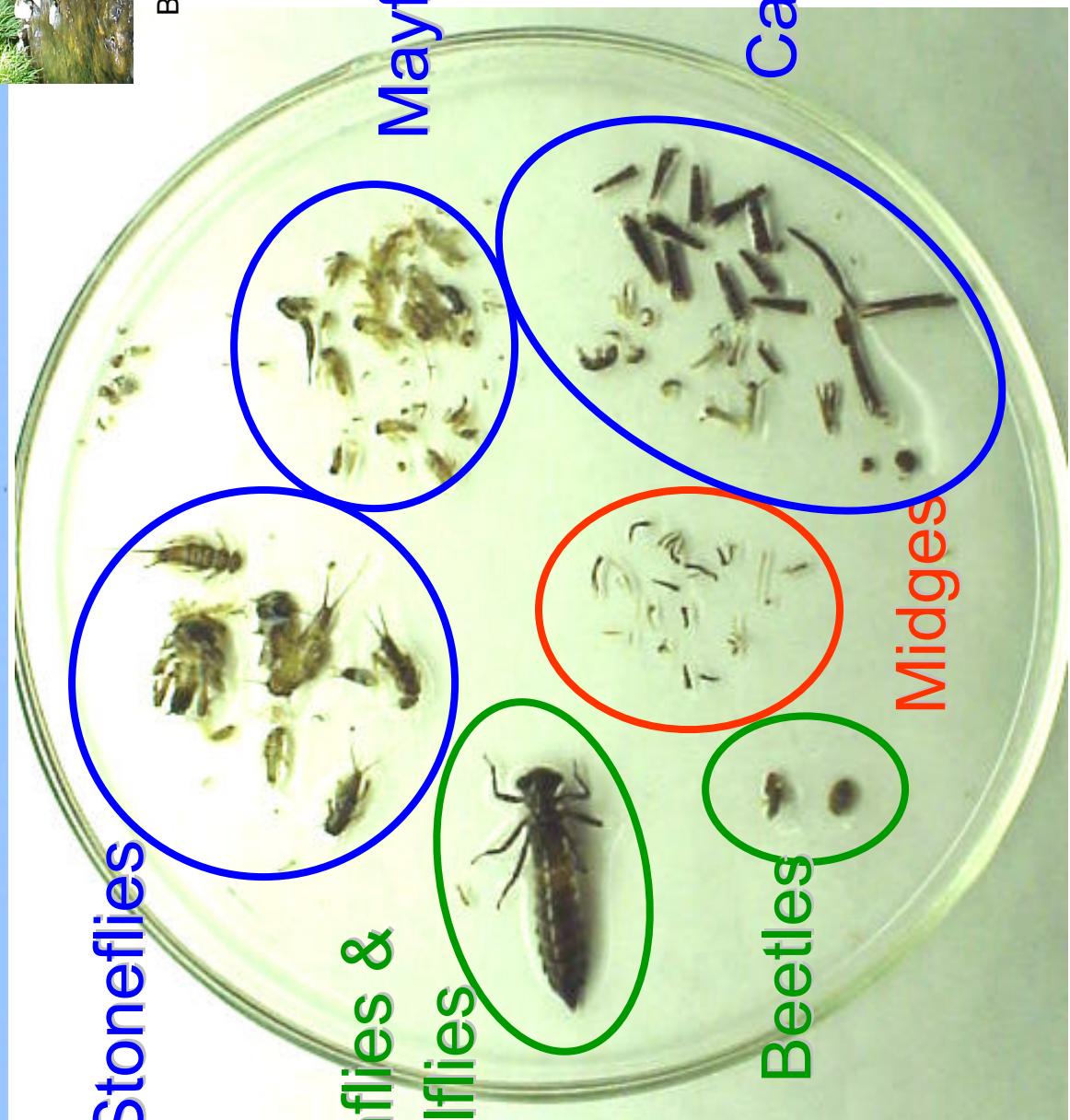
Macroinvertebrate Sampling



Class A Stream



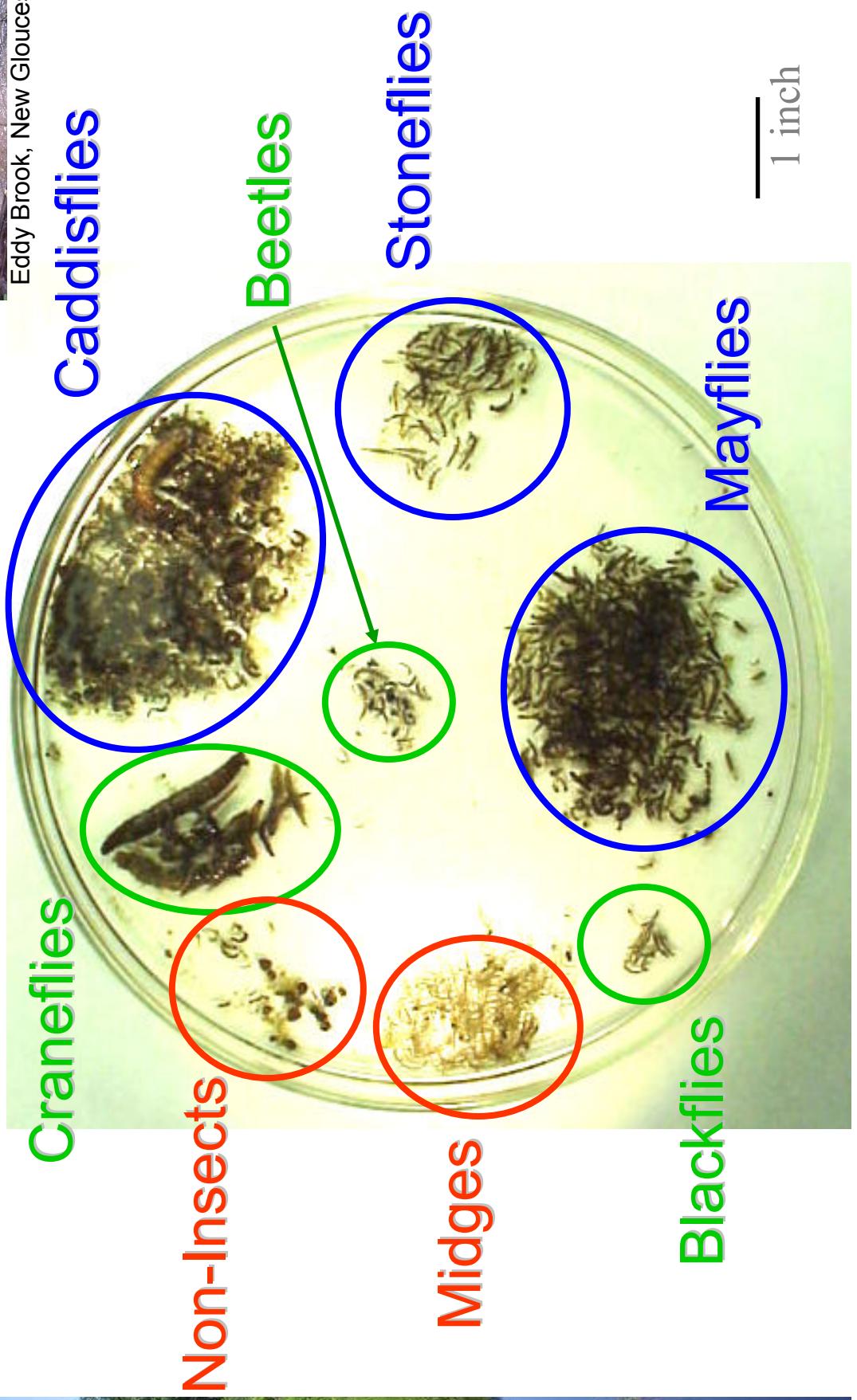
Babel Brook, T5 R9 NWP



Class B Stream



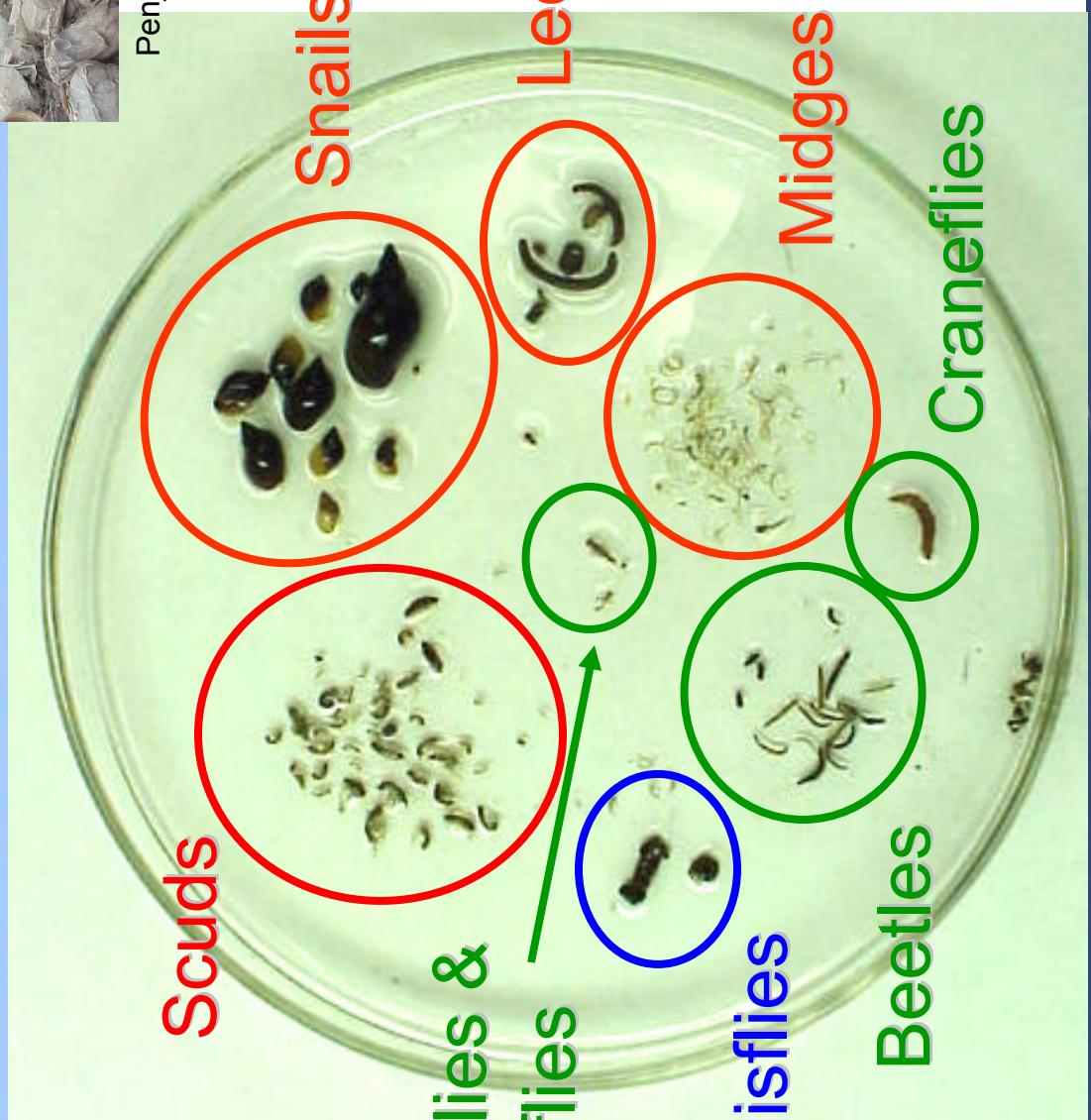
Eddy Brook, New Gloucester



Non-Affainment Stream

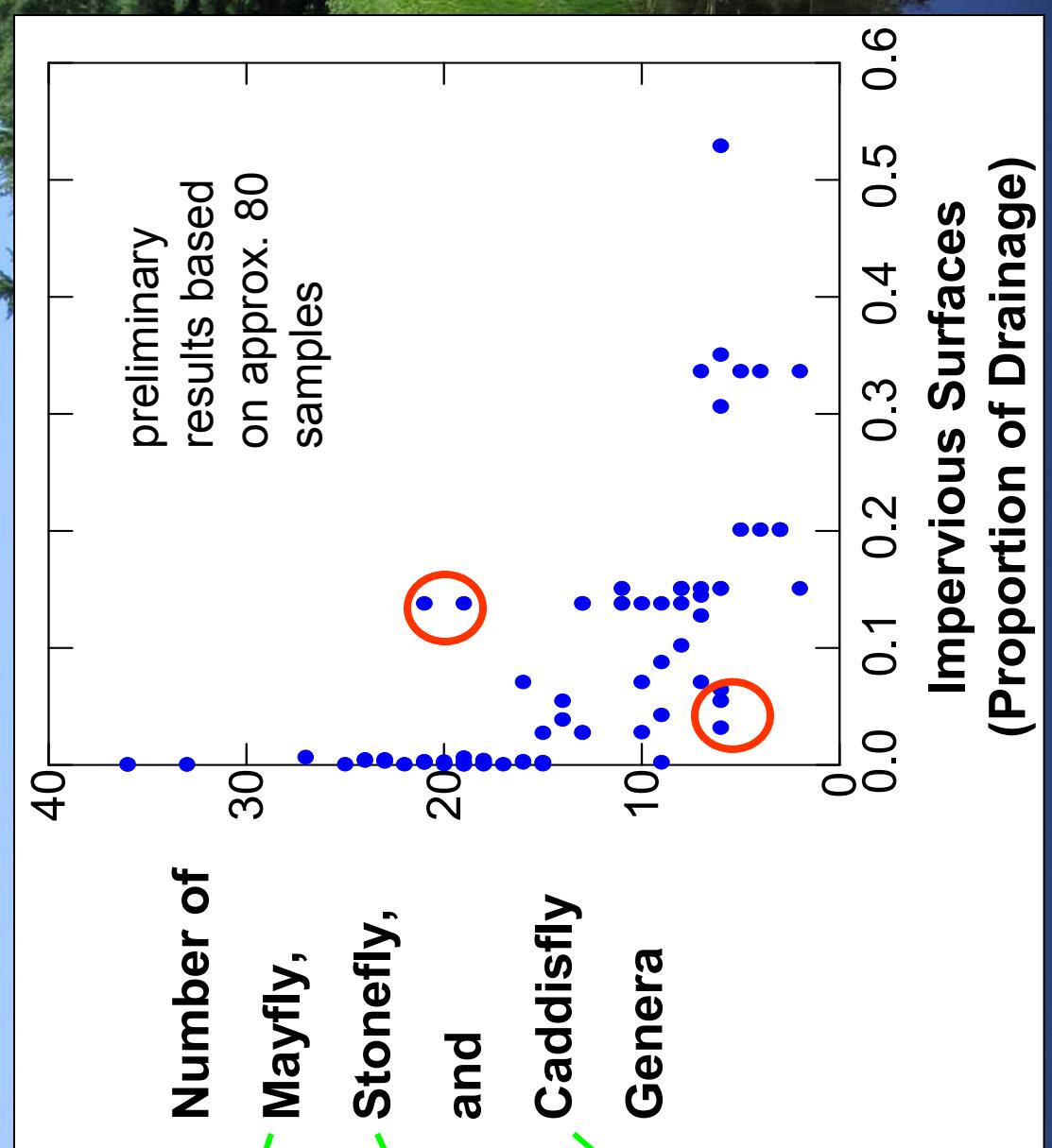


Penjajawoc Stream, Bangor



1 inch

Relationship between Impervious Surfaces and Stream Macroinvertebrates



Determining if a Stream Attains its Class

- Statistical model
 - 26 variables, such as the richness of mayflies, stoneflies, and caddisflies.
 - Predicts the probability of a stream attaining Class A, B, or C conditions.

Classification Attainment

Statutory Class	Monitoring Result	Attains Class?	Next Step
A	A	Yes	--
B	B	Yes	--
C	B	No	TMDL
	A	No	TMDL
	B	NA	

Keep Streams Healthy

- Maintain buffers of natural vegetation.
- Minimize amount and size of stream crossings.
- Use wide, open-bottom culverts.
- Avoid direct discharges of storm water.
- Treat storm water and discharge underground where possible.

Developing New Tools

- Wetland Macroinvertebrates and Algae
 - since 1998
- Stream Algae
 - since 1999
- Nutrient Criteria

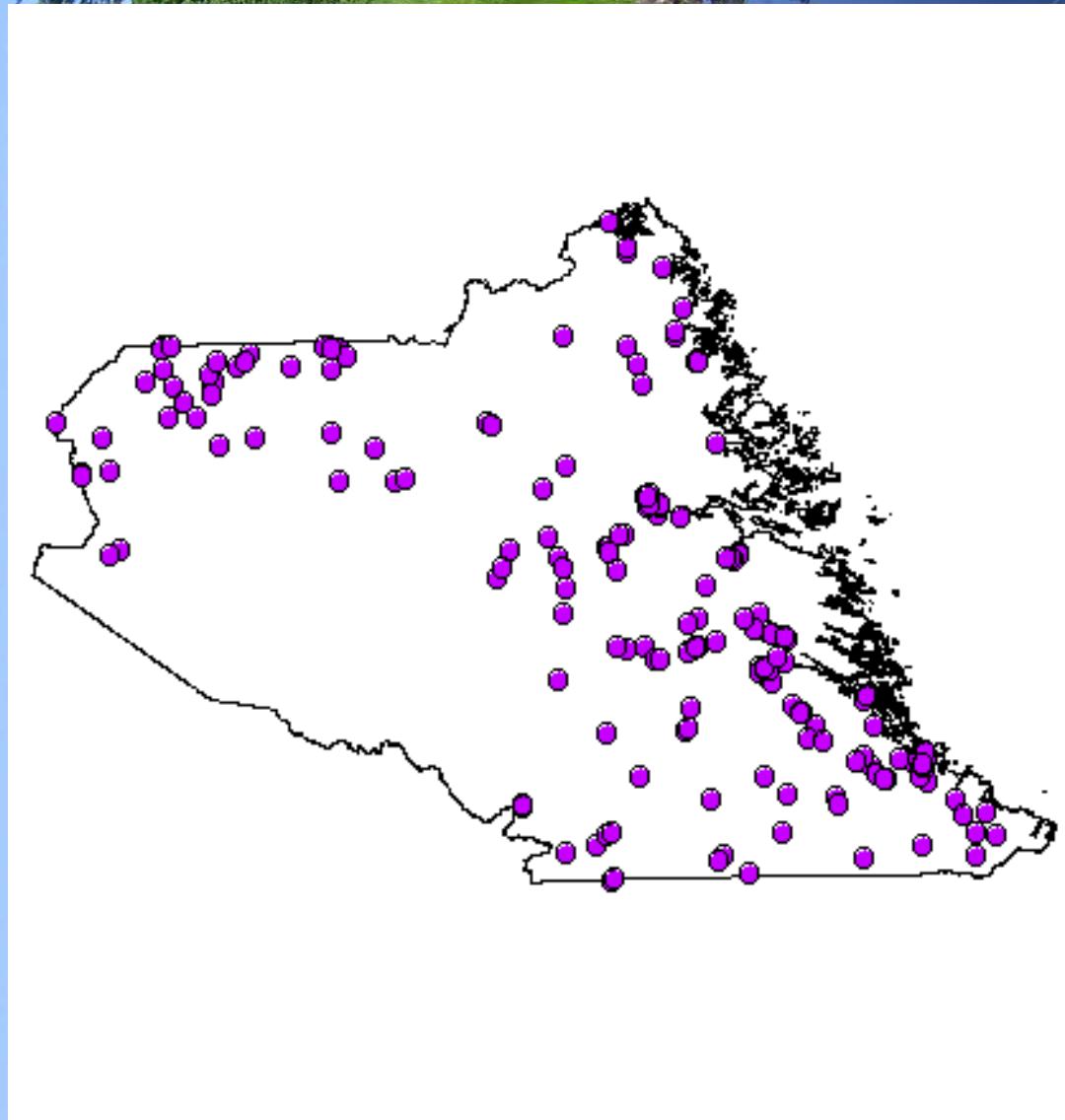
Measuring Stream Velocity



Avoid Method in Maine Wetlands



Stream Algae Sample Locations



Stream Algae Sampling

Natural Substrate



Artificial Substrate



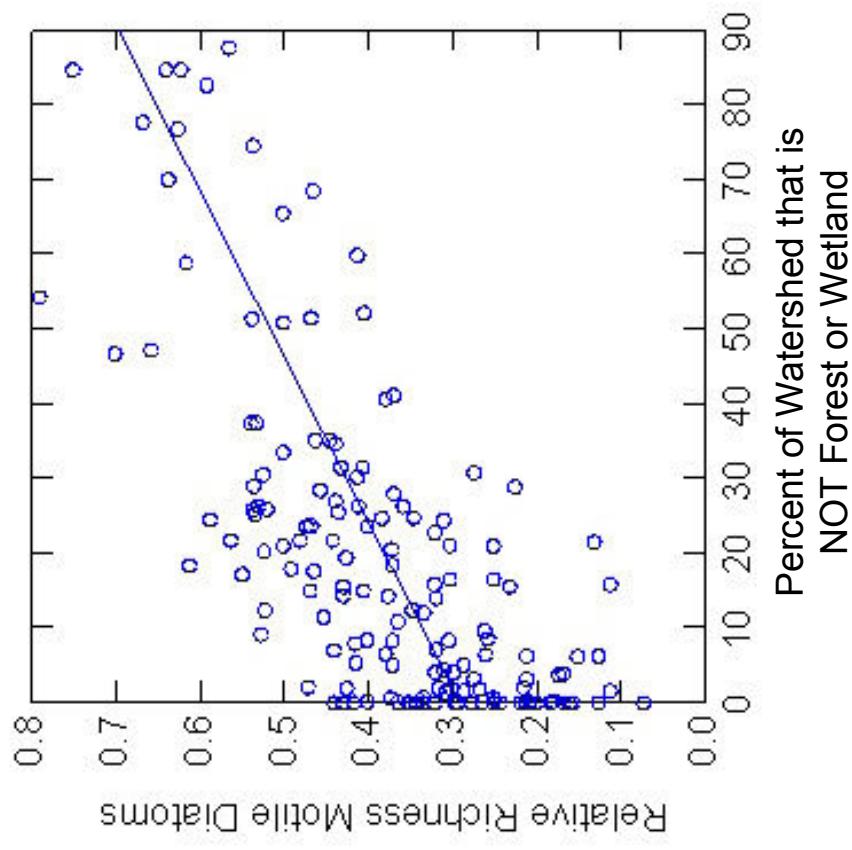
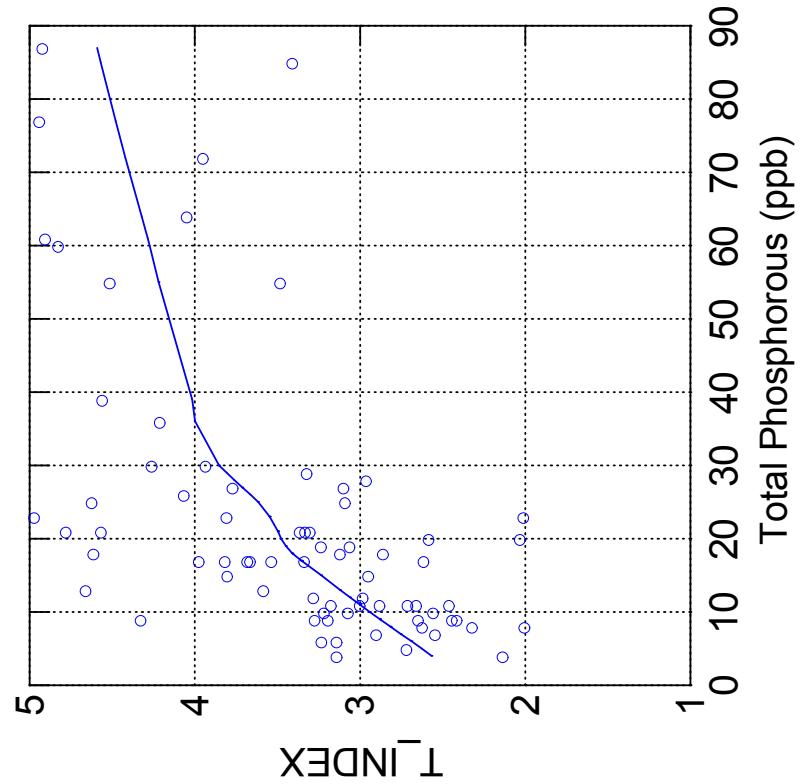
Viewing Bucket Survey



Don't Confuse Brushes!



TP vs. Algal Attributes



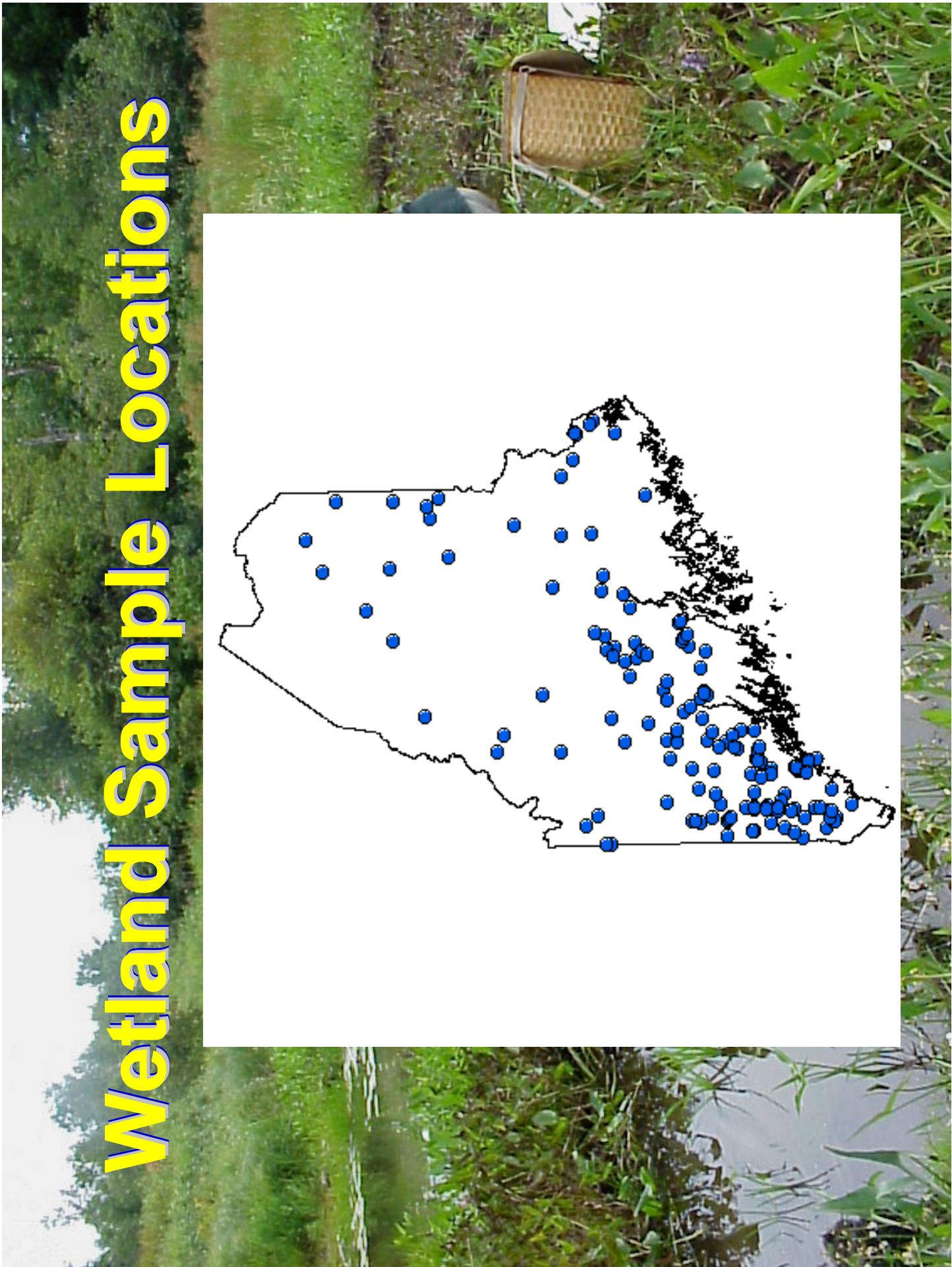
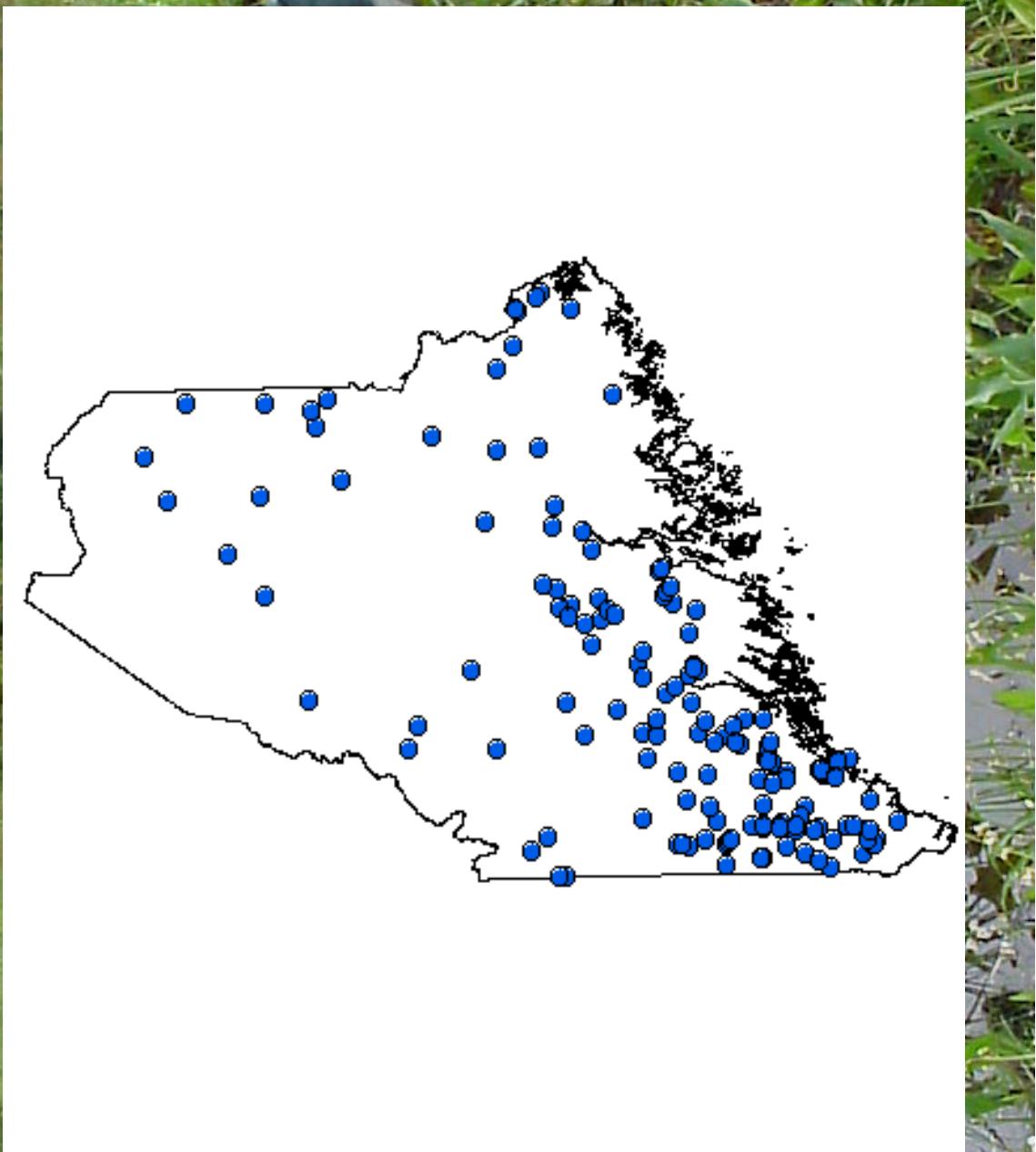
Percent of Watershed that is
NOT Forest or Wetland

Wetland Sampling

- Macroinvertebrates
- Epiphytic Algae
- Plankton
- Water Chemistry



Wetland Sample Locations



Healthy Wetland



Unhealthy Wetland



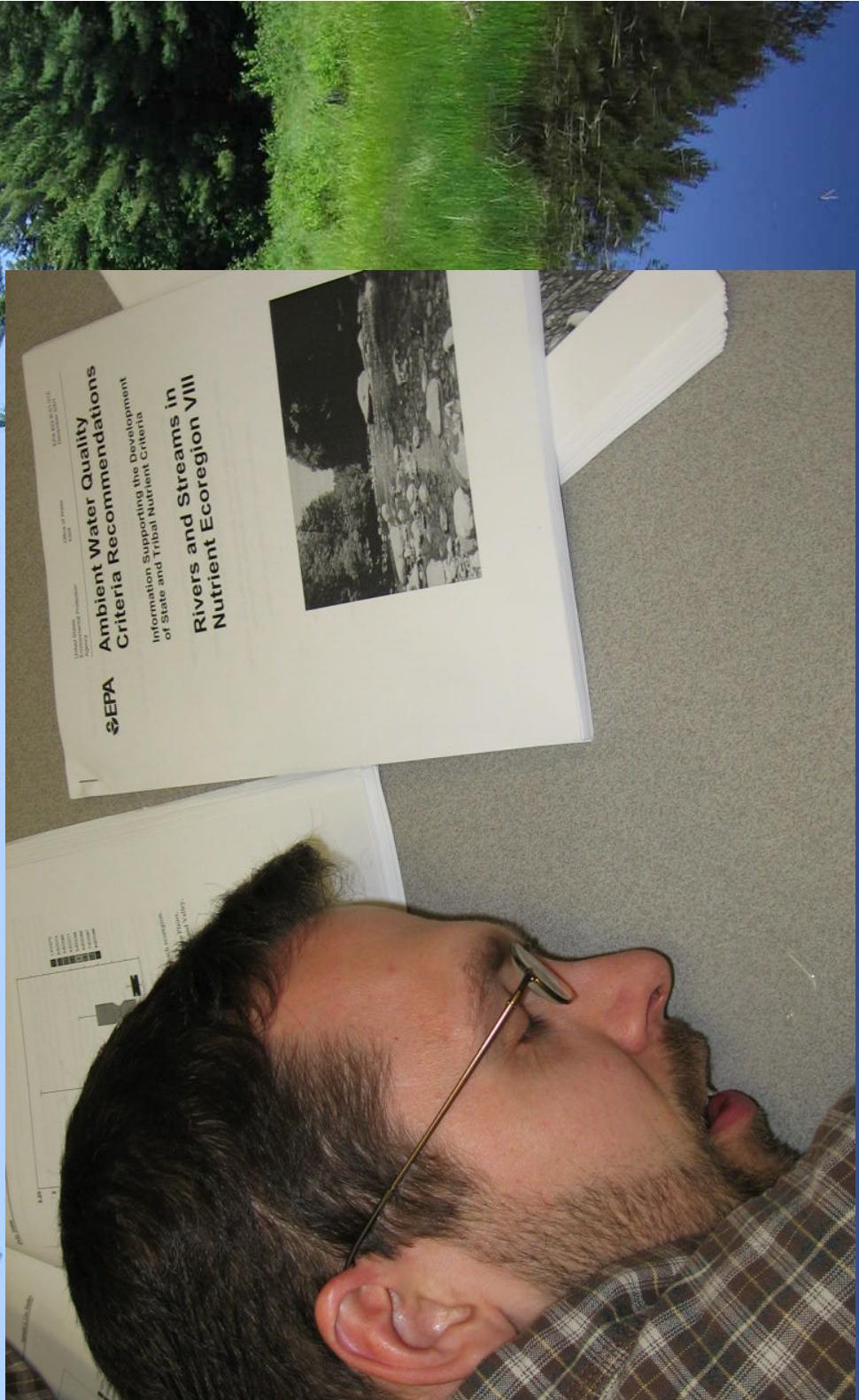
Other

Midges
and
Worms

Nutrient Criteria

- U.S. EPA requires states to adopt nutrient criteria
- States can develop own criteria or adopt EPA's criteria
 - Lakes
 - Rivers & Streams
 - Wetlands (future)
 - Estuaries (future)

Carefully Reviewed EPA Guidance

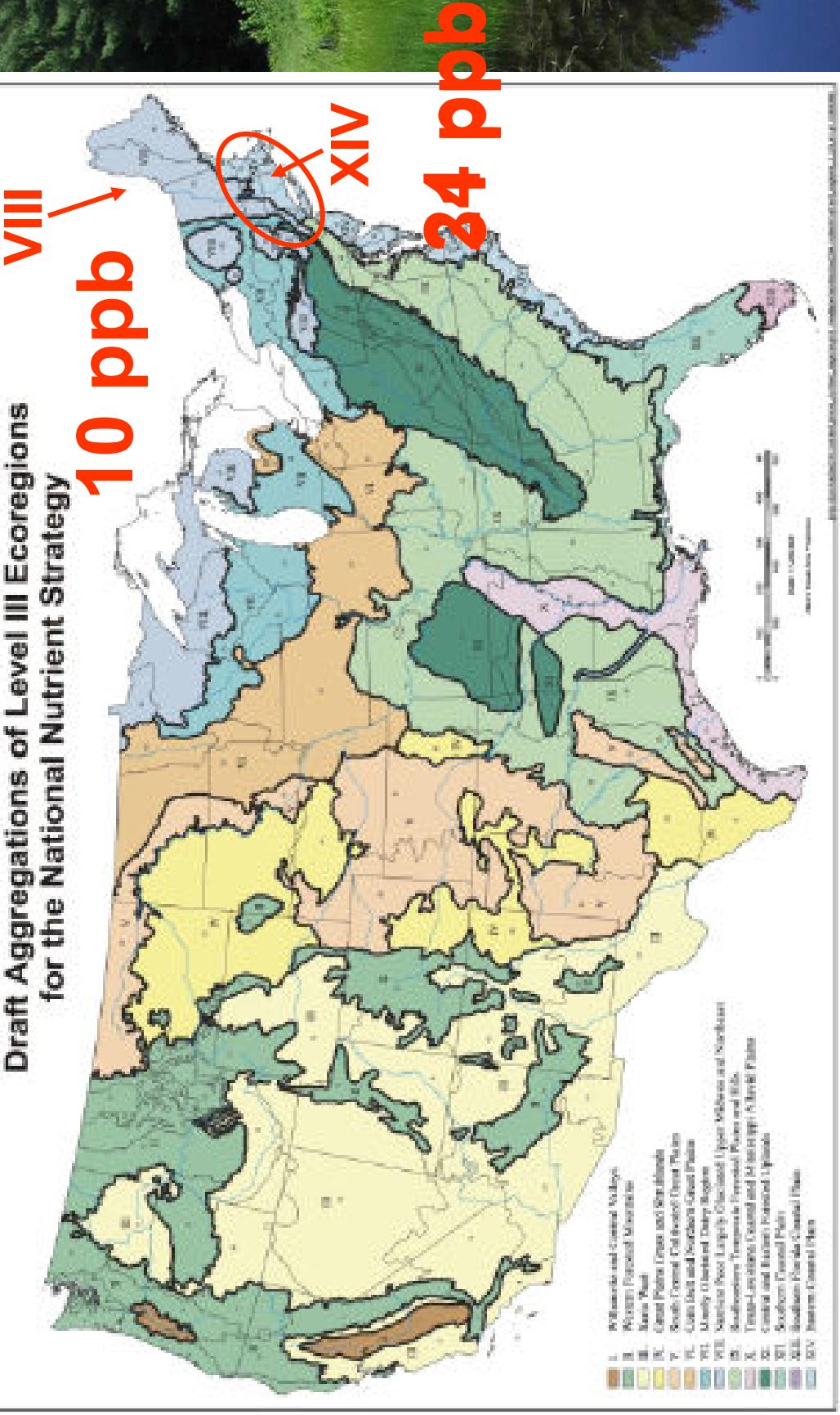


U.S. EPA Interim Criteria

- Divided country into nutrient regions
- Set criteria at 25th percentile of available data
- Included few data points from Maine
- Used the “one size fits all” approach

U.S. EPA Interim TP Limits for Streams and Rivers

Draft Aggregations of Level III Ecoregions
for the National Nutrient Strategy



Maine DEP's Approach

- Set nutrient limits for each Class (AA/A, B, and C)
- Use biological information to help set nutrient limits
- Develop a nutrient criteria decision framework that incorporates both nutrient limits and ecological response variables

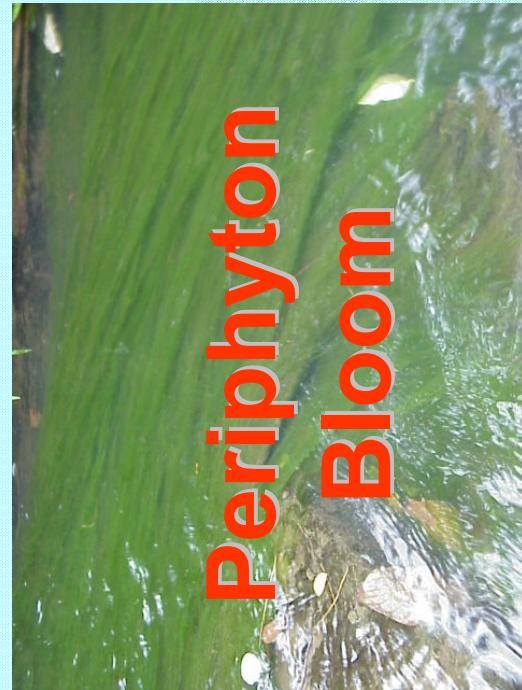
Nutrient Criteria Decision Framework

- Combines the nutrient limits with ecological response variables.
- Goal is to improve management decisions.

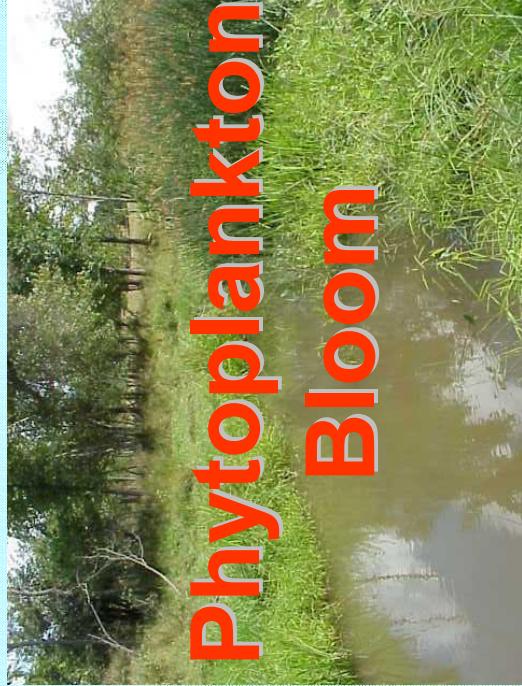
DRAFT TP Limits

Class	TP Limit	Rationale
AA/A	20 ppb	Most minimally disturbed streams have TP concentrations less than 20 ppb.
B	33 ppb	Most streams with > 33 ppb TP do not attain class B aquatic life criteria (based on macroinvertebrates).
C	40 ppb	Most streams with >40 ppb TP do not attain class C aquatic life criteria (based on macroinvertebrates).
GPA Lakes	15 ppb	Most lakes with TP concentrations below 15 ppb do not have algal blooms.

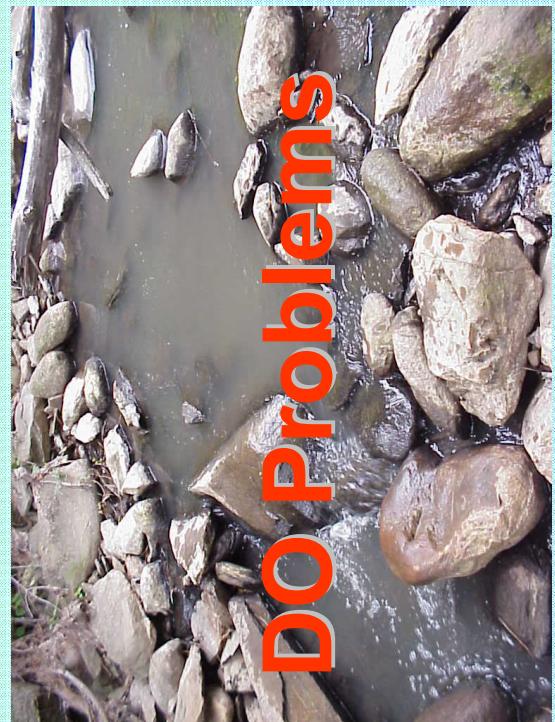
Ecological Response Variables



Phytoplankton Bloom



Periphyton Bloom



DO Problems



Sewage Fungus

Nutrient Criteria Framework for Each Class

Concentration of nutrient is BELLOW limit	Concentration of nutrient is ABOVE limit
<p>Attains Nutrient Criteria</p> 	<p>Violates Nutrient Criteria</p> 
<p>Ecological response is acceptable</p>	<p>Ecological response is NOT acceptable</p>

Indeterminate Results

Concentration of nutrient is BELLOW limit	Concentration of nutrient is ABOVE limit
<p>Ecological response is acceptable</p> <p>(1) Attains Nutrient Criteria</p>	<p>(2) Violates Nutrient Criteria</p> <p>(3) Collect more data</p>
<p>Ecological response is NOT acceptable</p>	

Acceptable Ecological Response

$TP \leq 40 \text{ ppb}$	$TP > 40 \text{ ppb}$	Attains <ul style="list-style-type: none">• site specific criteria?• downstream effects?	
Ecological response is acceptable		Ecological response is NOT acceptable	

Atypical Situations

- Naturally high nutrient levels

- Site specific criteria
 - Nitrogen or carbon
 - Establish site-specific limits when necessary to maintain or restore a waterbody

Conclusions

- Aquatic life are better indicators of stream and wetland health than chemical measurements.
- DEP uses macroinvertebrates to evaluate the health of streams.
- DEP is developing other tools to measure:
 - Stream algae
 - Wetland bugs and algae
 - Nutrient Criteria